ESA-066-2 American Refining Group - Bradford, PA
Public Report

Introduction:
Tom Maheady completed a steam ESA at American Refining Group in Bradford, Pennsylvania from May 8 to 10, 2007. The refinery is spread out along Tunungwant Creek in northwestern Pennsylvania. The boiler house is situated toward the west end of the site, so steam is distributed not only to process users in the vicinity of the boiler house, but also more than a mile in above-ground pipes to outlying crude oil unloading facilities and tank farms. The boiler plant houses one Zurn 165 MMBTU; 640 psig/725F bituminous coal-fired boiler and two Zurn/Erie 99 MMBTU refinery gas/natural gas-fired boilers, also operating at 640 psig/725F. Coal and refinery gas are the fuels of choice, with the ratio of refinery gas dictated by production parameters. At current prices, natural gas is burned only when absolutely necessary. Heavy fuel oil is also burned at the facility, but not in the steam boilers. If the process balance reaches a point where insufficient refinery gas is being produced to satisfy the steam load, rather than augment the boilers with natural gas, one process heater is supplemented with No. 6 oil to reduce its fuel gas demand, thereby re-balancing the overall energy picture to utilize the least-cost mix of fuels. The management staff and the operators in the individual process units are well-versed in working together to optimize this energy/fuel balance.

There are nine active backpressure steam turbines, involving all three steam headers (HP, MP & LP), and all driving process equipment (fans, pumps and compressors.) Balancing the system to eliminate venting steam is well-understood by, and a priority of, the operational staff. There is already a project in the works to increase the capacity of an induced-draft fan drive turbine to increase operational flexibility of the steam system.

Objective of ESA:
To train plant staff in use of the DOE software tools, to jointly build an accurate model of the plant steam system using SSAT, and to identify steam system best practices and energy saving opportunities.

Focus of Assessment:
Steam systems at a petroleum refinery, including one 165 MMBTU and two 99 MMBTU steam boilers, all operating at 640 psig/700F superheat, including numerous backpressure turbines and process end uses.

Approach for ESA:
Three-day ESA, including training, fact-finding and analysis of potential projects. The following agenda was followed:

Day 1:

- Brief initiation meeting to identify goals of the activity and introduce ESA Expert to Site Representatives
- Safety briefing
- Overview of DOE Tools:
    - 3 E Plus
    - SSST
    - SSAT
- Brief steam system overview
- Agree on potential energy efficiency opportunities to investigate
- Establish time and attendance for a Preliminary Findings Closeout Meeting
- Initiate Data Collection for Potential Opportunities

Day 2:

- Continue data collection
- Apply DOE Tool to quantify potential opportunities
- Refine SSAT model

- Plant Lead and Expert agree on opportunity results

Day 3:

- Wrap up tool analyses
- Establish a "Roadmap" for future activities
- Plant lead and expert ensure they agree on opportunity results
- Modify recommendations based on information attained during the Preliminary Findings Meeting
- Closeout meeting to review results

SSST Results:

"Save Energy Now" Energy Savings Assessment

American Refining Group – Bradford, PA

Summary of Steam System Scoping Tool (SSST) Results

Area	**ARG**	**Industry Avg**	**Perfect**
Steam System Profiling	**80**	**56**	**90**
Action: Additional metering at process equipment level			
Steam System Operating	**132**	**97**	**140**
Action: Address steam leaks and insulation deficiencies			
Boiler Plant Operating	**65**	**50**	**80**
Action: More frequent efficiency tests; better control of excess air; decrease blowdown			
Distribution Operating	**23**	**17**	**30**
Action: Improve condensate return			
Overall	**300**	**220**	**340**

ENERGY SAVINGS OPPORTUNITY SUMMARY INFORMATION					
	Savings/yr*				
Identified Opportunity	**$**	**kWh**	**MMBtu**	**Fuel Type**	**N,M,L**
1. Increase condensate recovery	141,000		27,000	User Defined	M
2. Decrease blowdown from 9% to 2%	23,000		1,752	User Defined	N
3. Re-insulate 12 tank roofs	54,000		12,264	User Defined	N
4. Increase boiler efficiency by 2%	130,000		30,660	User Defined	M
5. Reduce MP demand by 5%	180,000		41,172	User Defined	L
6. Reduce LP demand by 5%	27,000		6,132	User Defined	L
7. Add cogen turbine (reduce present 26,000 pph average HP to MP letdown flow)	138,000	3,730,000	-14,900	User Defined	L
8. Increase efficiency of blowdown heat exchanger	28,000		7,008	User Defined	N

* Note: These are estimated savings determined during the assessment. A more detailed engineering study should be performed to validate these figures before a capital project is undertaken.

Opportunities	MMBtu Savings	% of Total
Near-Term	21,000	17
Medium-Term	57,660	46
Long-Term*	47,304	38
Total	125,964	

* Note: Does not include cogen project (Opportunity 7)

Opportunity 1 – Increase condensate recovery (Medium-Term)
Presently, condensate return percentage from the MP and LP systems is about 25%. A large portion of what is not collected is due to direct consumption of steam in process units. However, there are also areas of the plant where even the condensate from indirect-steam-use applications is not returned. In the past, it was not seen as being economical to install a condensate return piping system. Given present energy costs, there is interest in taking another look at this. Our preliminary analysis for this opportunity suggests that the condensate return percentage from the LP system can be increased to 40%.

Opportunity 2 – Decrease blowdown rate from 9% to 2%
Presently, boiler blowdown rate is at about 9%. Investigation revealed that this is due to high silica content in the make-up water supply. The plant should explore the issue further to determine the cost and complexity of improving the present water treatment system to achieve more effective silica removal. We modeled the energy savings associated with a reduction of the blowdown rate to 2%. Since there is already a heat recovery system on the boiler blowdown, savings were not as dramatic as they might otherwise be. See also Opportunity 8 below.

Opportunity 3 - Re-insulate twelve tank roofs
There are hundreds of heated product storage tanks throughout the refinery. On some of these, the tank roof insulation has blown off and has not been replaced. There was a feeling that this represented a substantial heat loss. Replacement of the insulation should show up as a reduction in the steam used by the tank heating coils. We modeled the reduction of heat loss using 3EPlus.

Opportunity 4 – Increase boiler efficiency by 2%
Boiler tests indicate efficiencies of 83 to 85%. Some of the control systems have been up-graded, but the overall plant master control is scheduled to be up-graded as well. The consensus is that an average overall boiler efficiency of about 2% is achievable with some additional reasonable investment in the control systems.

Opportunity 5 – Reduce MP steam demand by 5%
Substantial quantities of steam are consumed by direct-injection into distillation columns, strippers and other process units. Although these units are for the most part state-of-the-art, plant staff is confident that process modeling software can be utilized to identify potential reductions on the order of 5%.

Opportunity 6 – Reduce LP steam demand by 5%
The bulk of the LP steam flow is used for overland pipe heat tracing and tank heating, via submerged coils, with temperature control by thermostatic traps. In both instances, there are some loads that continue to operate even in warm weather, when tracing and heating are not necessary. By taking a closer look at the possibility of zoning these systems with some additional automatic control valves, it is realistic that LP steam use can be reduced by 5%.

Opportunity 7 – Install backpressure cogen turbine
Plant engineers have already pursued a project to install a cogeneration backpressure turbine to essentially eliminate let down steam flow under all conditions. However, the relatively low cost of electricity, coupled with un-foreseen utility interconnection costs, washed out the economics of the project. It is not seen as a viable project in the short term.

Opportunity 8 – Increase boiler blowdown heat exchanger efficiency
There is an existing boiler surface blowdown heat exchanger, which is mentioned in Opportunity 2 above. There is some question about its actual operating efficiency, and preliminary proposals have already been solicited to repair it. This opportunity models the assumption that the exchanger is presently operating inefficiently, and will achieve peak performance after the repairs. Opportunity 2 modeled the reduction of boiler blowdown with an assumption that the present heat exchanger efficiency is average.

Management Support and Comments:
Plant management and staff indicated an interest in using the tools on an ongoing basis to explore identified and additional energy saving opportunities.

DOE Contact at Plant/Company: (who DOE would contact for follow-up regarding progress in implementing ESA results…) See Plant Lead identified above.